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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 08/916,629
Filing Date: August 22, 1997
Appellant(s): COBBLEY ET AL.

Stephen A Gratton
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed January 30, 2006 appealing from the Office action mailed September 12, 2005.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

No amendment after final has been filed.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

(A) Listing of Evidence Relied Upon

4,713,235	Krall	12-1987
5,690,766	Zwick	11-1997
97/06953	Trustees of the University of Pennsylvania (PCT)	2-1997
5,233,131	Liang et al	8-1993
5,218,229	Farnworth	6-1993
5,214,307	Davis	5-1993
5,140,404	Fogal et al	8-1992
4,107,347	Mitsubishi Denki (German)	12-1991
58-196280	TDK Corp (Japan)	11-1983

Chorbadjiev, K.G., et al, "The effect of fillers upon the properties of electroconductive cyanoacrylate adhesives", International Journal of Adhesion and Adhesives, Vol. 8, No. 3, July 1988, pages 143-146.

The Admitted Prior Art as characterized on page 11 of the response dated September 12, 2001 in patented file Serial Number 09/274128 (the child application to this application) as well as the specification at pages 2-3, page 2, lines 10-22 and page 9, line 22-page 10, line 2.

Loctite Product Data Description Product 410, October 1996, 2 pages.

Loctite Product Description Sheet Product 416, October 1988, 2 pages.

(B) Brief Description of Evidence Relied Upon

Krall suggested that it was known at the time the invention was made to utilize a methyl cyanoacrylate adhesive to join contact leads to a chip in the manufacture of electronic microchips.

Chorbadjiev et al suggested that those skilled in the art of electronics and the manufacture of electrical components would have understood that the use of cyanoacrylate adhesives had various advantages when compared to epoxy adhesives (heat cured thermosets) which included short set times, one component adhesives, strong bonding with various materials, good electroconductivity and ease of handling.

The **Admitted Prior Art** suggested that the formulation of a cyanoacrylate or anaerobic adhesive material which cured in less than 60 seconds was well known in the art although it had "not heretofore been used to construct a semiconductor package as presently claimed" as admitted in the response dated 9-12-01 in child file 09/274,128. Additionally, the appellant has admitted at the time the invention was made that conventional high speed die attachment systems were known per se in the art and included the use of a leadframe having paddles for attaching each die to the leadframe, a leadframe feed mechanism for manipulating a leadframe, a vacuum tool for manipulating a dice, a dispensing mechanism for applying a desired volume of adhesive to mounting paddles, and a die support platform for placing the dice in contact with the mounting paddles with the required pressure (see page 2, lines 10-22, page 9, line 22-page 10, line 2 of the specification).

Either one of **Zwick** or **PCT '953** suggested that those skilled in the art at the time the invention was made to employ the specified volume of adhesive identified to

obtain the desired finished thickness of adhesive between the chip and the leadframe in the assembly operation wherein the adhesive was applied in liquid form and pressure was applied to contact the die to the leadframe.

The references to either one of **Loctite 410** or **Loctite 416** suggested that those skilled in the art would have readily recognized that cyanoacrylate adhesives having a set (cure) time of less than 60 seconds were readily commercially available to the ordinary artisan.

The references to any one of **Liang et al**, **Fogal et al**, **Farnworth**, **Davis** and **German Patent '347** all suggested that "wire bonding" was the association of a wire between a chip and the leads of a leadframe in the art and that it was known to employ an adhesive like an epoxy type adhesive to join a chip to a leadframe in accordance with the state of the prior art.

Japanese Patent '280 suggested that those skilled in the art would have known to employ an anaerobic adhesive to join a chip to a substrate in the manufacture of a semiconductor device and that such anaerobic adhesive had an extremely fast setting time.

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1-20 and 42-44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Krall in view of Chorbadjiev et al, the admitted prior art, either one of Loctite 410 or Loctite 416 and either one of Zwick or PCT WO 07/06953 and optionally

further taken with the state of the prior art as exemplified by at least one of Liang et al, Fogal et al, Farnworth, Davis, and German Patent 4107347.

Krall taught that it was known at the time the invention was made in the art of manufacturing electronic microchips to utilize methyl cyanoacrylate or other cyanoacrylates as an adhesive for joining contact leads to chips. Since the major failure mode of chips occurs at the chip lead interface, it would have been advantageous if such cyanoacrylate adhesives were radiopaque so that the weld could be examined, see column 1, lines 42-53. Clearly, it was known at the time the invention was made to utilize a cyanoacrylate adhesive to join the contact leads of a leadframe to a chip. The reference failed to make mention of the speed with which the cyanoacrylate adhesive cured in the operation. The reference additionally failed to teach that one skilled in the art at the time the invention was made would have employed a die attach mechanism to assemble the die to the leadframe wherein the same included aligning mechanisms to ensure proper alignment of the chip to the leadframe as well as a vacuum tool for manipulating the die and a dispensing means for application of the adhesive upon the leadframe or die. It should be noted that some means must have been provided for in the manufacture of a die on leadframe assembly, however the reference to Krall is silent as to the nature of the same.

In the art of manufacturing electronic components (such as the attachment of a chip to leads), the reference to Chorbadjiev et al (the article entitled "The effect of fillers upon properties of electroconductive cyanoacrylate adhesives" from the International Journal of Adhesion and Adhesives, July 1988) suggested that cyanoacrylate adhesives

when compared to traditional epoxy adhesives had the following strong points: (1) short setting time at room temperature; (2) one component adhesives; (3) strong bonding action; (4) easy to work with, and; (5) satisfactory electroconductivity of adhesive bonds. It should be noted that the reference to Chorbadjiev et al is concerned with the manufacture of an electroconductive adhesive material (which is was one would have utilized to join the chip to the leads in Krall). The reference clearly suggested that the curing times would have been short with cyanoacrylate and additionally provided additional reasoning as to why those skilled in the art at the time the invention was made would have selected cyanoacrylate adhesives for the bonding of the chip to the lead of the leadframe. The reference, nonetheless, did not expressly state that the material would have cured in less than one minute at room temperature (20-30 degrees C) to between 90-100% crosslink density (polymerization). Additionally, the reference is silent as to the systems employed to attach the die to the leadframe (whether employing cyanoacrylate adhesive or epoxies).

However, the appellant has repeatedly admitted that the cure times are intrinsically a property of cyanoacrylate adhesives (see page 11, of the response dated 9-12-2001 in child patented file Serial Number 09/274,128, for example):

> "In this regard, Applicant would submit that although cyanoacrylate adhesives and anaerobic adhesives, which are formulated to cure in less than sixty seconds, are known in the art, they have not heretofore been used to construct a semiconductor package as presently claimed."

Clearly, the quick curing of the adhesive was known per se in the art. Additionally, those skilled in the art at the time the invention was made would have understood that the die attachment operation would have been performed in a manufacturing environment for

high speed productivity wherein such processing would have included the use of the conventional die attachment systems known in the art. Such systems as described by appellant in the specification (admitted as known by appellant) included the use of a leadframe having several paddles for attaching each die to the leadframe (page 2, lines 10-22), a leadframe feed mechanism for manipulating the leadframes, a vacuum tool for manipulating the dice, a dispensing mechanism for applying a desired volume of adhesive to the mounting paddles, an optical alignment device for aligning the dice to the mounting paddles, and a die support platform for placing the dice in contact with the mounting paddles with a required pressure (see page 9, line 22-page 10; line 2 of the specification). Clearly, appellant has admitted that the system for attaching the die to the leadframe was known per se in the art and included the use of the dispenser for depositing the adhesive, an alignment apparatus for properly aligning the die to the leadframe, a vacuum tool for manipulating the die and a pressing mechanism to press the die to the paddle of the leadframe. One would have been motivated to employ a cyanoacrylate adhesive in the operation (the device) for the reasons identified by Krall and Chorbadjiev et al.

As evidenced by Loctite 410 and Loctite 416, commercially available quick curing cyanoacrylate adhesives existed which cured within 60 seconds at room temperature to complete cure (100% polymerization). The appellant is referred to the spec sheets of Loctite 410 and Loctite 416 for the specific curing properties achieved with the use of the same. It would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize a cyanoacrylate adhesive to join leads of a leadframe to a

semiconductor chip as such was suggested by Krall wherein the cyanoacrylate adhesive would have been known to have incorporated an electrically conductive filler therein in order to facilitate electrical conductivity whereby such an adhesive had a quick cure time as evidenced by Chorbadjiev et al and wherein the adhesive was known to have had a cure time within less than one minute at room temperature as suggested by the applicant's admitted prior art and either one of Loctite 410 or Loctite 416 wherein the processing for attach the die to the leadframe utilized commercially available and conventional components for facilitating the automated placement of the die to the leadframe as admitted were known by appellant's admitted prior art. The combination of references failed to recognize the specified volume of adhesive applied and the resulting thickness of the adhesive layer in the semiconductor assembly or the specified desirability of forming the same.

The references to either one of Zwick or PCT '953 suggested that those skilled in the art at the time the invention was made would have understood that for a chip having a size of 5mm by 5mm that the typical thickness of the adhesive after polymerization of the same was 25 microns (or 0.984 mils) wherein the chip was assembled to the leadframe with liquid adhesive droplets and wherein the chip was pressed against the leadframe in the bonding operation, see column 1, lines 23-28 of Zwick and page 1, lines 20-25 of PCT '953. It is clear that one skilled in the art would have desired for a chip size (surface area) of 25 mm^2 (5mm by 5mm) to have an adhesive layer of a thickness of 0.984 mils. The chip size appellant uses in the specification is 4.4 mm by 9.4 mm (or an area of 41.36 mm^2). One would have expected that the volume of

adhesive utilized to achieve the thickness of the adhesive for a chip having a surface area of 64% of the surface area of the disclosed chip (i.e. 25mm^2 is 64% of the size of the chip surface area disclosed) would have fallen within the claimed range as an increased amount would have been applied to obtain the needed coverage for the assembly to provide a spacing of 25 microns for the thickness of the adhesive layer. Additionally, appellant is advised that as the value for the thickness fell within the middle of the range, one would have expected that the amount utilized for the volume of adhesive would have been within the middle of the recited range. Had one reduced this amount by 36% it still would have fallen within the range of weight of material applied to secure the chip upon the leadframe. Appellant is advised that the references to both of Zwick and PCT '953 suggested that those versed in the art would have applied pressure to the assembly when attaching the chip to the leadframe wherein the pressure applied was uniform over the entire surface. The appellant is advised that one skilled in the art would have applied the pressure necessary to obtain an adequate bond and good surface contact (as well as spreading of the adhesive material therein). The appellant is advised that one skilled in the art would have known to apply a pressure within the specified range in order to achieve the desired bond and that the claimed range of pressure is taken as conventional in the art of joining a die to a leadframe. As noted above the specific pressure applied is not clearly recited as pressure must be identified as a force per unit area and no area has been identified. As such, the reference by applying force to assemble the components must teach the specified force.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to utilize a cyanoacrylate adhesive to join leads of a leadframe to a semiconductor chip as such was suggested by Krall wherein the cyanoacrylate adhesive would have been known to have incorporated an electrically conductive filler therein in order to facilitate electrical conductivity whereby such an adhesive had a quick cure time as evidenced by Chorbadjiev et al and wherein the adhesive was known to have had a cure time within less than one minute at room temperature as suggested by the applicant's admitted prior art and either one of Loctite 410 or Loctite 416 wherein the processing for attach the die to the leadframe utilized commercially available and conventional components for facilitating the automated placement of the die to the leadframe as admitted were known by applicant's admitted prior art wherein one applied pressure and drops of the adhesive in such a manner to yield an adhesive thickness in the finished assembly between 0.2 to 2.0 mils in thickness as suggested by either one of PCT WO 97/06953 or Zwick..

With regard to the various dependent claims, the appellant is advised that the admitted prior art suggested that chip on lead assembly was known per se as well as wire bonding and encapsulating the same. the appellant's disclosed contribution (and the application has been argued as such) to the art was the recognition that cyanoacrylate adhesives would have been useful for joining leads to a chip in the semiconductor art and that no reference suggested the same. The reference to Krall suggested the use of cyanoacrylate adhesives to join a chip to leads of a leadframe. The particular configuration of the semiconductor assembly would have been selected

dependent upon the desired demands of the customer and are within the skill level of the ordinary artisan to select (the various chip arrangements and lead arrangements are taken as conventional in the art). The appellant is additionally advised that one skilled in the art would have known to incorporate a filler such as an electrically conductive filler in the resin as suggested by Chorbadjiev et al.

Krall suggested that cyanoacrylate adhesive would have been useful for joining a chip to a lead in the manufacture of a semiconductor package. The reference did not expressly state that the chip was assembled to the leadframe but rather referred to the chip being attached to the leads with adhesive. It should be noted that the reference clearly did not refer to "wire bonding" as addressed by appellant. The reference was silent as to what was meant by chip to lead attachment. The appellant is advised that one skilled in the art would have been expected to have basic knowledge of the art and one skilled in the art would have been expected to use common sense and common knowledge from the art, In re Bozek, 163 USPQ 545. The ordinary artisan is presumed to know more than what he reads in the references, he is presumed to have sufficient basic knowledge to apply and combine features of the prior art, In re Sovish, 226 USPQ 771, In re Bode, 191 USPQ 12.

The references to any one of Liang et al, Fogal et al, Farnworth, Davis, and German Patent 4107347 all suggested that one skilled in the art would have known that "wire bonding" was associating a wire between the chip and the leads and that the wire bonding operation did not include the use of adhesive to join the wire to the chip and the lead. Appellant is referred to the drawings of each document. Additionally, each

reference suggested that one skilled in the art would have incorporated an adhesive like an epoxy between the chip and/or die and the leadframe at the paddle of the leadframe. In each of these references, this is where the chip and the lead frame interface is taught and where the same is joined with adhesive. The appellant is also referred to the admitted prior art of this application, where the applicant admitted that it was known to join a chip to a leadframe with epoxy adhesive for example, see pages 2-3 of the specification and note that the admitted prior art also suggested that "wire bonding" was in fact a separate and distinct operation from the adhesive bonding operation. Clearly, one viewing the state of the prior art as exemplified by at least one of Liang et al, Fogal et al, Farnworth, Davis, and German Patent 4107347. Certainly, then, when one skilled in the art viewed Krall, one skilled in the art would have understood that the operation where adhesive was used would have included the joining of the chip to the paddle of the leadframe (since this is the place where the chip is associated with adhesive in the operation of associating a chip to a lead) with the cyanoacrylate adhesive.

Claims 21, 22,40 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over the admitted prior art in view of either one of Zwick or PCT WO 97/06953 and Japanese Patent 58-196,280.

The admitted prior art suggested that it was known to join a chip to a leadframe with an epoxy adhesive material, see pages 2 and 3 of the specification. Additionally, those skilled in the art at the time the invention was made would have understood that the die attachment operation would have been performed in a manufacturing environment for high speed productivity wherein such processing would have included

the use of the conventional die attachment systems known in the art. Such systems as described by appellant in the specification (admitted as known by applicant) included the use of a leadframe having several paddles for attaching each die to the leadframe (page 2, lines 10-22), a leadframe feed mechanism for manipulating the leadframes, a vacuum tool for manipulating the dice, a dispensing mechanism for applying a desired volume of adhesive to the mounting paddles, an optical alignment device for aligning the dice to the mounting paddles, and a die support platform for placing the dice in contact with the mounting paddles with a required pressure (see page 9, line 22-page 10, line 2 of the specification). Clearly, appellant has admitted that the system for attaching the die to the leadframe was known per se in the art and included the use of the dispenser for depositing the adhesive, an alignment apparatus for properly aligning the die to the leadframe, a vacuum tool for manipulating the die and a pressing mechanism to press the die to the paddle of the leadframe. The appellant also admitted that anaerobic and cyanoacrylate adhesives were known in the prior art and had been formulated to cure in less than 60 seconds but that the same were not known to have been used to construct a semiconductor package. The appellant did not admit that it would have been useful to provide the specified volume of adhesive to join the chip to the leadframe.

The references to either one of Zwick or PCT '953 suggested that those skilled in the art at the time the invention was made would have understood that for a chip having a size of 5mm by 5mm that the typical thickness of the adhesive after polymerization of the same was 25 microns (or 0.984 mils) wherein the chip was assembled to the

leadframe with liquid adhesive droplets and wherein the chip was pressed against the leadframe in the bonding operation, see column 1, lines 23-28 of Zwick and page 1, lines 20-25 of PCT '953. It is clear that one skilled in the art would have desired for a chip size (surface area) of 25 mm^2 (5mm by 5mm) to have an adhesive layer of a thickness of 0.984 mils. The chip size applicant uses in the specification is 4.4 mm by 9.4 mm (or an area of 41.36 mm^2). One would have expected that the volume of adhesive utilized to achieve the thickness of the adhesive for a chip having a surface area of 64% of the surface area of the disclosed chip (i.e. 25mm^2 is 64% of the size of the chip surface area disclosed) would have fallen within the claimed range as an increased amount would have been applied to obtain the needed coverage for the assembly to provide a spacing of 25 microns for the thickness of the adhesive layer. Additionally, appellant is advised that as the value for the thickness fell within the middle of the range, one would have expected that the amount utilized for the volume of adhesive would have been within the middle of the recited range. Had one reduced this amount by 36% it still would have fallen within the range of weight of material applied to secure the chip upon the leadframe. Appellant is advised that the references to both of Zwick and PCT '953 suggested that those versed in the art would have applied pressure to the assembly when attaching the chip to the leadframe wherein the pressure applied was uniform over the entire surface. The appellant is advised that one skilled in the art would have applied the pressure necessary to obtain an adequate bond and good surface contact (as well as spreading of the adhesive material therein). The appellant is advised that one skilled in the art would have known to apply a pressure within the

specified range in order to achieve the desired bond and that the claimed range of pressure is taken as conventional in the art of joining a die to a leadframe. As noted above the specific pressure applied is not clearly recited as pressure must be identified as a force per unit area and no area has been identified. As such, the reference by applying force to assemble the components must teach the specified force. The combination, nonetheless, failed to recognize that it would have been desirable to utilize an anaerobic adhesive in the operation.

The reference to Japanese Patent '280 suggested that it was known to utilize an anaerobic adhesive to join a chip to leads of a board in the manufacture of a semiconductor assembly wherein the anaerobic adhesive material was an acrylic anaerobic adhesive material. The reference failed to make mention of the specific cure times of the anaerobic adhesive material, however it did suggest that the cure times would have been fast. Additionally, the abstract suggested that the adhesive would have included filler therein in order to render the adhesive material electrically conductive. It would have been obvious to employ the quick curing adhesives of Japanese Patent '280 in the operation of joining a chip to a leadframe as such use of anaerobic adhesives would have sped up productivity where the processing included the use of conventional die attachment operations such as those admitted by appellant's admitted prior art wherein the volume of adhesive applied was adequate to provide a desired final thickness to the adhesive disposed between the chip and the leadframe as taught by either one of Zwick or PCT WO 97/06953.

(10) Response to Argument

1. Rejections of Claims 1-20 and 42-44

(A) Lack of Disclosure of Limitations in the Prior Art

The appellant initially notes that the rejection of claims 1-20 and 42-44 have been traversed because the claims include limitations which have not been taught or suggested by the prior art as required by MPEP 2142, 2143. The appellant is advised that when one views the prior art when taken as a whole for what was fairly taught or suggested, one skilled in the art would have been led to practice the claimed invention> The appellants then addresses specific limitations which they believe to be missing from the prior art of record. It should be noted in this regard that one skilled in the art is expected to have basic knowledge of the art and one skilled in the art would have been expected to use common sense and common knowledge from the art, In re Bozek, 163 USPQ 545. The ordinary artisan is presumed to know more than what he reads in the references, he is presumed to have sufficient basic knowledge to apply and combine features of the prior art, In re Sovish, 226 USPQ 771, In re Bode, 191 USPQ 12.

I. Claims 1-20 and 42-44

The appellant notes regarding specifically claims 1-20 and 42-44 that a semiconductor packaging method which included the steps of providing a cyanoacrylate adhesive formulated to cure in less than 60 seconds at a temperature between 20-30 degrees C, applying the cyanoacrylate adhesive to a die or a leadframe, and then polymerizing the cyanoacrylate adhesive without heating the die or leadframe in less than 60 seconds was not found in the prior art of record because the prior art of record

failed to teach the use of cyanoacrylate adhesives (and the prior art of record appears to have taught the use of heating or acoustic vibration of the die or leadframe over a period of several minutes to cure the adhesive). This is not persuasive. The reference to Krall clearly expressed that those versed in the art would have been well aware of the use of cyanoacrylate adhesives in the manufacture of a semiconductor package where a chip was joined to a leadframe with such cyanoacrylate adhesive. True, the reference to Krall does not expressly state that the adhesive was cured within 60 seconds or less without the application of heat, however one versed in the art would have understood that the incorporation of conventionally commercially available cyanoacrylate adhesives like those of Loctite 410 or 416 as well as those of appellant's admitted prior art would have resulted in the use of cyanoacrylate adhesive materials which would have cured within 60 seconds or less. Additionally, one of the advantages of the use of cyanoacrylate adhesives as noted by Chorbadjiev et al was that these adhesives cured quickly and did not need the heating associated with epoxy adhesives for example to cure and these adhesives provided an ease of handling as well. Certainly, one skilled in the art would have understood how to use these adhesives to set a chip on a leadframe in less than 60 seconds.

II. Claims 6-20

The appellant next argues relating to claims 6-20 that the use of a die attach system or a die attacher in a semiconductor packaging method to apply cyanoacrylate adhesive and press the die to the leadframe together was not found in the prior art rejection. The appellant does state that such systems were known in the art but that

they heretofore had not been used with cyanoacrylate adhesives. The appellant is advised that the admitted prior art suggested that such systems were commonplace and used with thermosetting adhesives like epoxy and polyester adhesives. One skilled in the art would have been expected to utilize the same systems currently present in the assembly line to manufacture the package with a different type of adhesive material. As expressed above, one skilled in the art would have used existing knowledge from the art to achieve the desired goals. As the attachment systems are already in place, one would have been expected to utilize the same in the usual manner to achieve bonding of the chip to the leadframe whether the chip and leadframe were joined with epoxy resin or cyanoacrylate resin. It is true that Krall does not express the system used to attach the chip to the leadframe but there is simply no reason to believe that one would not have utilized the existing systems for this operation and one viewing the prior art as a whole would have been led to utilize the same.

III. Claims 42-44

The appellant argues that there is no evidence that one skilled in the art would have incorporated a filler configured to tailor the characteristics of the adhesive layer in the package of the chip and leadframe. The appellant is advised that the reference to Chorbadjiev et al suggested that one skilled in the art would have added suitable fillers to the cyanoacrylate adhesive in order to provide the same with the desired conductivity. The use of fillers which make the adhesive conductive would have been understood to have been desirable in the operation of joining a chip to a leadframe in order to ensure that the a desired electrical connection can be made between the chip

and leadframe, for example. Certainly, the use of fillers would have been within the purview of the ordinary artisan.

Discussions of Krall

The appellant notes that the reference to Krall at column 1, lines 47-53 taught that:

> "For instance, in the manufacture of electronic micro-ships it has been suggested that MCA may be a useful adhesive for joining contact leads to the chips. Since a major failure mode of electronic chips occurs at the chip-lead interface, it would be advantageous if such cyanoacrylate adhesives were radiopaque so that the weld could be examined."

The appellant argues that this cited passage does not disclose or suggest that a semiconductor packaging method which included providing a cyanoacrylate adhesive formulated to cure in less than 60 seconds at a temperature between 20-30 degrees C, applying the cyanoacrylate adhesive to a die or a leadframe, and then polymerizing the cyanoacrylate adhesive without heating the die or leadframe in less than 60 seconds was known. However, it clearly expressed that it was known in the art of manufacturing a semiconductor package to utilize a cyanoacrylate adhesive to join a chip to a leadframe. As noted above, appellant is the child application to this application admitted that cyanoacrylate adhesives which cure in less than 60 seconds were readily commercially available, however these adhesives were not utilized in packaging techniques as claimed (note that Krall clearly evidenced that it was known to utilize the cyanoacrylate adhesives in the packaging operation). To utilize commercially available cyanoacrylate adhesives like those of the admitted prior art, Loctite 410 or Loctite 416 would have been within the purview of the ordinary artisan. Note that utilization of the

same in the processing described by Krall would have resulted in the adhesive setting in less than 60 seconds. Additionally, as expressed above, the manner in which one applied the cyanoacrylate adhesives to the chip or leadframe would have included conventionally and commercially available techniques such as those identified by appellant's admitted prior art (the die attachers).

The appellant argues that the conventional wisdom in the art would have been to utilize heat or vibration curing of the adhesives including the cyanoacrylate adhesives since previously this was the manner in which these adhesives were cured. The appellant is advised that those skilled in the art would have readily appreciated that cyanoacrylate adhesives (super glue) do not require heating to cure the same and that their cure times were very rapid in comparison with thermosetting resins like epoxy, see for example Chorbadjiev et al who expressly stated that one of the merits of the use of cyanoacrylate adhesives was its short setting times at room temperature and either one of Loctite 410 or Loctite 416 who suggested that the curing took place under normal room temperature conditions. Clearly, one skilled in the art would have readily recognized that one of the advantages of the use of cyanoacrylate adhesives was its short set time at room temperature and would not have proceeded to heat the chip or the leadframe in the assembly process as such additional heating operation added cost to the bonding process without improving the bonding results. As noted above, one skilled in the art would have been expected to utilize their basic knowledge in the processing and such would have included the fact that bonding with cyanoacrylate

adhesives does not require the use of heat to set the adhesive (i.e. super glue bonds quickly at room temperature which was well known to the ordinary artisan).

The appellant argues that the examiner has reviewed the evidence before him from the viewpoint of an experienced examiner and with the knowledge of the present application before him and that in accordance with W.L. Gore & Associates v. Garlock, Inc , 220 USPQ 303 one must attempt to go back in time to the time the invention was made to view the prior art. Doing so does not change the facts presented herein. One skilled in the art viewing the teachings of Krall would have been motivated to employ conventional processing to make a package wherein one utilized the cyanoacrylate adhesive to join the chip to the leadframe. It is noteworthy to recognize that the reference to Krall discussed the use of the cyanoacrylate adhesive in the background of the invention as it seems to lead credence to the fact that the use of cyanoacrylate adhesive to join a chip to a leadframe was well known in the art at the time of Krall's invention. Note that the invention in Krall was the use of the cyanoacrylate adhesive in a medical procedure and thus one reading Krall would have been led to believe that the inventor therein received the information regarding the use of cyanoacrylate adhesives and joining a chip to a leadframe from the adhesive manufacturer themselves. As such, it seems reasonable to assume that those skilled in the art at the time the invention was made would have been well aware of Krall and the use of the adhesive therein to join a chip to a leadframe. Appellant notes that there was a 10-year difference between the issuance of Krall and the filing of the present invention and over that time conventional wisdom was to employ heat or vibration curing for the adhesive. Nonetheless, it was

known to employ an adhesive which was a quick curing cyanoacrylate adhesive in order to , for example, ensure that there was adequate contact between the chip and the lead interface (wherein radiopaque cyanoacrylate adhesives were employed). Clearly, it was known to the artisan as early as 1987 that cyanoacrylate adhesives would; have been suitable for the processing. The appellant argues that none of the later filed evidence indicated that cyanoacrylate adhesive was used to join a chip to a leadframe and this supports the conclusion that it was not performed. This is not well taken. The reference clearly was concerned with a good connection, and an electrical connection, between a chip and a lead in a semiconductor package. It would have been understood that such an arrangement was between a chip and a leadframe as this is what a chip is attached to in packaging as was well known in the art. Clearly, ten years prior to the filing of this invention, it was known to employ a cyanoacrylate adhesive to join a semiconductor chip to a lead. The manner in which one performed the same would have been with the conventionally known methods which included the use of a chip applicator of the admitted prior art as well as well known cyanoacrylate adhesives which had a set time of less than 60 seconds without heating. Appellant's arguments are not well taken in this regard.

The appellant argues that the statement in Krall that MCA may be a useful adhesive for joining contact leads to the chips is merely a hypothetical usage of the adhesive. The appellant is advised that because Krall is primarily concerned with a new use of cyanoacrylate adhesive in the sterilization of females (a surgical application), it would appear that the description regarding the use of the adhesive for assembly of

chips in packages clearly was derived from the adhesive manufacturer. As such, it would appear that the usage was not hypothetical but rather was the accepted and known use of radiopaque cyanoacrylate adhesives.

Discussions of Chorbadjiev et al, the admitted prior art, Zwick, PCT WO '953, Loctite 410 and Loctite 416

The appellant argues that the reference to Chorbadjiev et al failed to disclose the use of the cyanoacrylate adhesive in semiconductor packaging where a die was attached to a leadframe. The appellant is advised that one cannot show nonobviousness by attacking references individually where a combination of references have been applied under 35 USC 103. Additionally, appellant is advised that one must consider what the prior art as a whole would have taught or suggested to the ordinary artisan. Here, the reference to Chorbadjiev et al clearly suggested that those versed in the art would have known the various advantages of cyanoacrylate adhesives in the manufacture of electrically conductive adhesive compositions and the merits of using the same instead of epoxy resins which required heat to set the same. It should be noted that chip to lead contacting (which was disclosed by Krall) is clearly an electrically conductive contact of the components. Additionally, while the reference did not expressly state that the operation was for a chip to a leadframe, the references to any one of Liang et al, Fogal et al, Farnworth, Davis, or German Patent '347 clearly envisioned what was understood regarding joining a chip to a leadframe with an adhesive material. It should be noted that the admitted prior art was to utilize epoxy type heat set adhesives for the purpose of joining the chip to the leadframe and the

reference to Chorbadjiev et al suggested the advantages of utilizing cyanoacrylate adhesives over epoxy adhesives. Clearly, one would have been motivated to employ a cyanoacrylate adhesive as opposed to a heat cured epoxy resin when making an electronic component like a package of a chip and a leadframe.

The appellant argues that the reference to Chorbadjiev et al taught a set time of 5-20 minutes which is at least 5 times slower than the times recited in the claims. The appellant is advised that: (1) well known and admitted cyanoacrylate adhesives had a set time of less than 60 seconds as established by appellant's admitted prior art, and; (2) the references to both of Loctite 410 and Loctite 416 clearly envisioned that one skilled in the art would have set the adhesives in less than a minute. While the cyanoacrylate adhesives of Chorbadjiev et al did not set for 5 minutes to 30 minutes, this was nonetheless recognized by Chorbadjiev et al as being speedier than epoxy set times where heating was employed. Additionally, one skilled in the art would have readily understood that cyanoacrylate adhesives would have been formulated for much faster set times where productivity increases where desired and the use of commercially and conventionally available cyanoacrylate adhesives would have been motivated by one skilled in the art. The appellant's arguments that the reference did not recite the merits of cyanoacrylate adhesives is not well taken.

The appellant then addresses the admitted prior art and describes the background of the invention where epoxy adhesives were discussed for joining the chip to the leadframe. The appellant admits that it was known to utilize conventional automated die attach machines to attach a die to a leadframe and that such existed.

The appellant states that "admittedly, fast cure times are an inherent characteristic of cyanoacrylate adhesives.". This is essentially what the admitted prior art of the child application specified. It was well known that cyanoacrylate adhesives would set (cure) within a minute after application. What appellant argues here is that it was not known at the time the invention was made to utilize the conventional application systems for attachment of the die to the leadframe with cyanoacrylate adhesives as they were previously only used with epoxy adhesives. Appellant is advised that obviousness does not require absolute certainty but rather only a reasonable expectation of success. Here, one would have reasonably expected that the incorporation of the cyanoacrylate adhesive with the conventionally utilized assembly systems would have provided for an adequate means for making the packaged assembly of the die and the leadframe. The evidence of record suggested that it was known to employ the cyanoacrylate adhesive instead of epoxy adhesives in electronic manufacture (Chorbadjiev et al) and was employed in the attachment of a lead to a chip (Krall). One would have reasonably expected that the use of the conventional and commercially available techniques and systems for attachment of the chip to the leadframe with epoxy resins would have also worked with cyanoacrylate adhesives and would have been motivated to utilize the same cyanoacrylate adhesives because of their advantages over epoxy as identified by Chorbadjiev et al as well as their ability to be readily inspected as suggested by Krall.

While the appellant contends that the invention was the recognition that cyanoacrylate adhesives could be set in less than 60 seconds to attach a die to a leadframe, the appellant is advised that such was first recognized in the art as

advantageous in the art of semiconductor manufacture more than ten years prior to the filing of this application by Krall. Additionally, the merits of using cyanoacrylate adhesives were likewise well known in the electronics industry as evidenced by Chorbadjiev et al. there is simply no reason to believe that the use of cyanoacrylate adhesive in the systems of the admitted prior art would have failed but rather there is every reason to believe that one skilled in the art would have been reasonably successful in applying the cyanoacrylate adhesives in the processing of the admitted prior art using the known cyanoacrylate adhesives which set in less than one minute.

Appellant is additionally advised that while the prior art systems employed a heating step to set the semiconductor die to the leadframe, one would have readily appreciated that such was unnecessary with the use of a cyanoacrylate adhesive which sets in place at room temperature in less than a minute (as appellant has repeatedly noted it was known that these adhesives set in less than one minute). Clearly, use of heating in the prior art systems when modifying the same with cyanoacrylate adhesive materials would have been eliminated as such would have been understood by the ordinary artisan as unnecessary and only lead to additional expense which was unnecessary.

Regarding the references to Zwick and PCT '953, the appellant argues that these references teach vibration of the adhesive using an acoustic speaker to form a thin uniform adhesive layer and that it is admitted that the thickness of the adhesive was clearly controlled in Zwick and PCT '953. the appellant is advised that the claims at hand do not exclude the use of an acoustic speaker system to vibrate the assembly.

Additionally, pressure was used to press the die against the leadframe in the operation of the prior art systems. While the claims recite that a specific volume of adhesive is applied and that this volume resulted in the specified thickness (and not an acoustic vibration operation), the appellant is advised that the thickness of the adhesive remaining in the finished assembly was intrinsically a value of the volume of adhesive applied and the manner in which the same was spread between the surfaces. As the references suggested the same resulting thickness in the finished assembly, they must have applied an adequate volume of adhesive to attain the specified thickness. Application of pressure whether it be pressing or with acoustic vibration would have spread the adhesive to form a uniform thickness layer. As the finished thickness was the recognized by either one of Zwick or PCT '953, one skilled in the art would have readily appreciated that the specified volume of adhesive material would have been applied in order to attain the desired thickness. It is noted that neither reference to Zwick or PCT '953 employed a cyanoacrylate adhesive material, however the use of the same in the operation instead of epoxy would have been within the purview of the ordinary artisan for the express reasons identified above.

Regarding the references to Loctite 410 and Loctite 416, the appellant argues that neither reference expressly stated that the cyanoacrylate adhesives therein were useful in bonding a semiconductor die to a leadframe despite the fact that the references both suggested that the cyanoacrylate adhesives cured within less than one minute. The appellant is advised that the references were merely cited to evidence that cyanoacrylate adhesives which were conventional and commercially available would

have set within one minute. Clearly, this was well recognized by the artisan. Additionally it should be noted that the reference to Krall clearly expressed the use of cyanoacrylate adhesives in the packaging of semiconductor die with leads (presumably of a leadframe) and the reference to Chorbadjiev et al expressed the advantages of cyanoacrylate adhesives in comparison to epoxies in the manufacture of electronics. Clearly, one skilled in the art would have selected a conventionally available adhesive material to perform the joining operation and such adhesive materials would have included Loctite 410 or Loctite 416 which were suitable for joining rubber, metals and plastics in various environments. There is no question that while Loctite 410 or Loctite 416 did not expressly state that these materials would have been used in semiconductor packaging that one skilled in the art would have found them useful in such an environment in light of the teachings of Chorbadjiev et al and Krall for example.

Discussion of the optional references to any one of Liang et al, Fogal et al Farnworth, Davis or German Patent '347

The appellant admitted that each of their references taught that it was commonplace to join a semiconductor die to a leadframe with an adhesive material. These references were cited to show the state of the art at the time the invention was made so that there would have been no misunderstanding as to what bonding was referred to in Krall. The appellant does not dispute this but rather takes the position that in each of the references the adhesive employed was set via a heating step and that none employed a cyanoacrylate adhesive. The appellant is advised that these references need not establish whether cyanoacrylate adhesive would have been used

in the operation or not as the reference to Krall clearly established the same. These references were added to show that one skilled in the art would have known what type of bonding was taking place in Krall and that the bonding operation was the attachment of the semiconductor die to the leadframe in the reference. This goes undisputed by appellant.

As established by the above noted discussions, the prior art did in fact teach all of the recited limitations in the claims and additionally one skilled in the art would have reasonably expected that the combination of cyanoacrylate adhesive with the known systems of the prior art would have operated in the usual manner and attached the die to the leadframe in less than a minute to achieve a good package. When viewing the prior art as a whole one skilled in the art would have reasonably expected success.

(B) Lack of Motivation to Combine the Prior Art

The appellant argues that there is no incentive to combine the references as Krall is viewed as non-analogous art. The appellant is advised, as has been repeatedly argued by the Office, that Krall is analogous as he clearly expressed the state of the prior art for cyanoacrylate adhesives at the time of Krall's invention. Krall is primarily concerned with a medical procedure, however this procedure was performed with cyanoacrylate adhesive. The reference is discussing the various uses of cyanoacrylate adhesives at the time the invention was made by Krall. Clearly, Krall is analogous to the problems faced herein. The appellant is advised that Krall stands alone for what it teaches to those of ordinary skill in the art. While the gist of the reference is related to the use of cyanoacrylate adhesives in a surgical procedure, the reference expressly

stated that those skilled in the art at the time the invention was made would have incorporated a cyanoacrylate adhesive to join a die to a leadframe where it states:

> "Radiopaque cyanoacrylate compositions are also useful for the general adhesive applications to which cyanoacrylates are put, such as the bonding of metal, plastic and ceramic parts. Radiopacity of such compositions allows inspection of the integrity of the joined seam. For instance, in the manufacture of electronic microchips it has been suggested that MCA may be a useful adhesive for joining contact leads to the chips. Since a major failure mode of electronic chips occurs at the chip-lead interface, it would be advantageous if such cyanoacrylate adhesives were radiopaque so that the weld could be examined." (column 1, lines 42-53, emphasis added)

Clearly, the reference to Krall on its face suggested that those skilled in the art of semiconductor manufacture would have been well aware that a cyanoacrylate adhesive would have been useful for attachment of the chip to the leadframe in the manufacture of the electronic components. While the reference does not go on in any further detail of the processing, the artisan in the art of semiconductor manufacture and the attachment of components to leadframes would have known what was going on in Krall. The artisan in semiconductor electronic manufacture is highly skilled and would have known how to use the teachings of Krall to manufacture a suitable end product (whether the gist of Krall relates to such or not is immaterial to the question of obvious as defined herein and the prima facie case which has been established).

2. Rejection of claims 21-22 and 40-41

A. Lack of Disclosure of Limitations in the Prior Art

Again appellant notes that various limitations were not found in the prior art when addressing claims 21, 22, 40, and 41 and refers to MPEP 2142 and 2143. The appellant is again advised that those skilled in the art would have understood that it was

necessary to consider what the prior art references taught to one skilled in the art as a whole.

I. Claims 21, 22, 40, and 41

The appellant argues that none of the prior art of record taught or suggested that one skilled in the art would have incorporated an anaerobic acrylic adhesive material in the operation of joining a die to a leadframe where the material sets in less than 1 minute at a temperature between 20 and 30 degrees C. this is not well taken. The reference to Japanese Patent '280 taught the use of an acrylic anaerobic adhesive to join a chip capacitor to a board base where the adhesive cured in a few seconds to scores of seconds (i.e. in less than a minute). The use of such an adhesive would have imparted an increased productivity when assembling a die to a leadframe of the admitted prior art and one skilled in the art would clearly have desired increased productivity.

II Claim 22

The appellant argues that none of the prior art suggested the use of a die attach system to attach the die to the leadframe with an acrylic anaerobic adhesive. While no single reference expressed the use of the same, the appellant is advised that the system for attachment of the die to the leadframe was known to the ordinary artisan as admitted as was known by appellant. While these systems were used in conjunction with epoxy adhesive materials, one would have expected that they would have been suitable for anaerobic adhesives and would have been led to employ the commercially available and conventional systems to practice the recited method.

Discussion of Prior art Applied

The appellant addresses the prior art applied against claims 21, 22, 40 and 41 and states regarding the admitted prior art that it was "conventional wisdom in the art " to "heat or vibrate curing of an adhesive in time periods of several minutes or more", however this is merely an assertion by appellant. While there is evidence that such systems did exist in the prior art, there is also evidence which has been presented which clearly suggested that anaerobic acrylic adhesives were known for joining a chip to a substrate in the packaging of an electronic device, for example Japanese Patent '280. while Japanese Patent '280 does not expressly state that it was for assembly of a semiconductor die to a leadframe, it is for electrically connecting a die component to a circuit board electrically. Additionally, the reference clearly employed an anaerobic adhesive for such purposes in order to hasten the ability to bond the assembly together. One viewing the same would have understood that the anaerobic adhesive would have been suitable for assembly of a die to a leadframe and that such processing did not need the addition of heat in order to quickly and effectively join the die to the leadframe.

The appellant next addresses the reference to Zwick and PCT '953 and states that these references related to the use of an epoxy adhesive to join the die to the leadframe and that these references related to the use of vibration to form a thin uniform adhesive layer where the only mention of volume relates to the volume of material which is exuded out from beneath the chip. The appellant is advised that these references clearly suggested the specified thickness of the adhesive layer to be disposed between the chip and the leadframe. The appellant is additionally advised that

those skilled in the art would have readily understood that the amount of adhesive present (the thickness of the adhesive) was a function of the amount of adhesive applied and the pressure applied in the bonding operation to allow an adequate amount to exude out from the assembly in order to obtain a predetermined amount of adhesive in the finished assembly. To provide for a specified thickness for the adhesive is therefore to provide a specified volume of adhesive initially applied to the assembly. True, the reference does relate to the application of epoxy adhesive upon the surface, however as expressed above, the use of an anaerobic acrylic adhesive would have been understood by the ordinary artisan as a suitable adhesive material for joining a chip to a leadframe in light of the teachings of Japanese Patent '280 wherein one would have been able to dispense with the heating step for securing the chip to the leadframe and increased productivity in the same breath. Regarding the use of an acoustic speaker to vibrate the assembly, it should be noted that the claims at hand do not exclude such a set and thus the argument is not commensurate in scope with the claims. It being noted nonetheless that the specified thickness of the adhesive n the finished assembly would have necessarily and intrinsically required a specific volume application of the adhesive. This is undisputed by appellant.

Regarding Japanese Patent '280, the appellant argues that the method disclosed therein does not disclose or suggest a semiconductor packaging method in which an anaerobic acrylic adhesive was formulated to set at a temperature of 20 to 30 degrees C in less than one minute and used to attach a die to a leadframe. This is not well taken. The reference to Japanese Patent '280 provided the conductive paste to

facilitate attachment of the chip capacitor to the base. The reference does provide a conductive component in the adhesive in order to render the attachment electrically conductive in the final assembly. The reference to Japanese Patent '280 clearly suggested that those skilled in the art would have provided a connection between the chip and the substrate in a fast manner in a matter of seconds without the need for heating (normal room temperature) and without having to use a temporary bonding operation. clearly, use of an anaerobic acrylic adhesive to join a semiconductor chip to a leadframe would have been useful as it would have set the components together in a short period of time without the need for application of heat. The Japanese Patent '280 therefore does in fact suggest or motivate one to utilize the anaerobic acrylic adhesive to join the chip to the leadframe.

B. No Incentive or Motivation to Combine the References

The appellant argues regarding claims 21, 22, 40 and 41 that proposed incentive or motivation for combining the references must come from the references themselves or knowledge generally available to one of ordinary skill in the art and that the statement that the use of anaerobic adhesives would have sped up productivity has no basis in the art or in the knowledge available to one skilled in the art. This is not well taken. It should be noted that the reference to Japanese Patent '280 clearly expressed that the bonding operation took a few seconds to take place at room temperature while the admitted known operation with epoxy required heating and took several minutes. Clearly, one skilled in the art would have been able to ascertain that bonding in a few seconds without having to introduce heat to effect the cure would have been more efficient and

would have allowed one to increase productivity of the packaged components while using less energy (heat) to effect a bond. It is intrinsic that if the speed of the bonding operation is reduced (the time it takes to develop a bond) that one would have increased production as the curing of the adhesive appears to have been a rate limiting step in the operation. Additionally note that the exclusion of the necessity of heating would clearly have motivated one skilled in the art to use the anaerobic acrylic adhesives. Clearly there was ample motivation for one skilled in the art to look to the anaerobic adhesives of Japanese Patent '280 to perform the bonding operation of the admitted prior art using conventional processing systems for attaching a chip to a leadframe.

Appellant is advised that when one considers the prior art as a whole for what it fairly taught or suggested to the ordinary artisan one skilled in the art would have been motivated to utilize either an anaerobic acrylic adhesive or a cyanoacrylate adhesive to attach a chip to a leadframe in the packaging of a semiconductor assembly in light of the evidence of record wherein the bonding would have taken place in less than a minute and without the introduction of heating to the assembly to set the adhesive.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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